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THE CARRYING TRADE OF THE GREAT LAKES.

BY ALLAN HENDRICKS.

EVERY well established system of water transportation has developed for itself the type of vessel that will best and most economically perform its services, and these types vary as widely as the conditions of the different trades in which they ply. The steamboat of the Mississippi River and its tributaries has long been considered the most distinctive of all American steam craft; but in the last few years there has been evolved upon the Great Lakes a model of freight carrier that is almost as individual as the Western river boat.

This type, to which all the largest lake freight carriers of recent build belong, and which is by far the most economical vessel for the conveyance of such freights as form the main items of Great Lake commerce, differs widely in design and construction from the ocean freighter or the older lake craft. The conditions under which transportation upon the lakes is carried on are by no means those that control on the ocean, and the requirements of each sort of transportation have produced the vessel best fitted to serve its ends. In length and in beam the new lake boats compare favorably with the better class of ocean-going cargo boats, but their depth is only two-thirds that of many of the latter. The carrying capacity of boats built on the lake model far exceeds that of ocean vessels of the same draft; in fact, of two boats of equal length and beam, one a lake freighter of the latest model and the other a salt water vessel, the lake steamer will carry as much on a draft of nineteen feet as will the ocean freighter on a draft of twenty-six feet. Two considerations which the lake shipbuilder constantly has in mind are, first, great carrying capacity on shallow draft, and second, such construction as will permit the greatest speed in loading and discharging the coarse freight for which the vessel is designed. Perhaps the most radical departure from the style of vessel employed on salt water was brought about by the remarkable development of the iron ore trade, which in tonnage is now the greatest of lake shipments.

The commerce of the Great Lakes has grown in an astonishing degree. The United States government already has done much in the way of improving the channels and harbors of the system, and the increase in the number and size of the vessels forming the lake merchant marine has kept pace with the deepening of the waterways, or rather it has been retarded only by it. The depth of water in the inter-lake passages at present is only sufficient for vessels drawing seventeen feet, but improvements now under way contemplate a navigable depth of almost nineteen feet. The new freight boats are designed to carry full cargoes on a draft of about twenty feet, and it is probable that before many years further improvements will give that depth throughout the lakes. These boats have very flat bottoms, lines that are by no means graceful, and a large number of hatchways, so spaced as to suit the docks and elevators of the lake ports. The midship section of such a vessel closely resembles that of a rather shallow box, and this not only in its exterior shape, but also in its unbroken interior space. The heavier weather that ocean vessels have to meet demands stronger construction than is required in the lake craft, and because of their lightness and simplicity of design, the latter cost less in proportion to their tonnage than do the steamers of the high seas.

In most of the new lake freighters there is no deck between the spar deck and the water bottom, and the bulkheads are few in comparison with the number on an ocean vessel. The water bottoms are safeguards against damage by grounding in shallow channelways, and they also give stability when, as frequently happens, vessels must go westward without cargo to load at uplake ports. The engines are placed in the extreme stern in order not to interfere with the rapid handling of freight, and as the speed required is not great, high power is unnecessary. The coal bunkers are small, and all the machinery is less powerful and less expensive than that on an ocean-going cargo boat. The docks at which these large lake vessels load and discharge their cargoes are supplied with facilities for transferring freight with a speed not attained in any ocean port, and hence the boats do not carry the many winches and derricks of salt water freighters.

Such are the vessels of the new lake fleet, designed to engage in the grain, iron ore, and coal trade. So far as their internal plan is concerned, the cargo capacity is cut by the bulkheads into a few large spaces, each of which is reached by several very broad hatchways. Into these spaces the bulk freight for which the boats are built is loaded with remarkable despatch, but in such vessels freight of that description only can profitably be carried. Ocean steamers, or lake steamers engaging in more general trade, must be of a design such as is suitable for a miscellaneous cargo in order that any freight may be loaded. The older vessels of the lake fleet, except for their small size, more nearly approach the ocean-going type. So rapid has been the evolution of the present lake freighter, and so different is it from the older craft, that the latter have lost value out of all proportion to their age.

The value of the Great Lakes system as an avenue for water transportation may be shown by a glance at the shipping upon it. The registered tonnage of the merchant marine of the United States upon salt water is 838,187, while that upon the lakes is 1,324,068. Statistics compiled by the United States Commissioner of Navigation show that on June 30, 1895, the number of steam vessels of 1,000 tons or over then plying the lakes was 360, whereas the number of such vessels registered on the entire seaboard was 309, including the great Atlantic steamers of the American line. It is further shown that the combined tonnage of the 360 lake vessels was 643,260 gross tons, while the gross tonnage of the 309 vessels sailing other waters was 652,598. According to the same statistics there were on the Atlantic and Gulf coasts at that date 626 iron or steel vessels aggregating 596,680 gross tons. On the lakes there were 194 such vessels, but their aggregate tonnage was 301,753. Thus the average gross tonnage of boats of that class on the lakes was 1,555, whereas that of coast vessels was 953.

These figures may seem surprising to the summer wanderer who regards the lakes principally as comfortable hot-weather resorts. Nevertheless it is true that barring one line of passenger steamships upon the Atlantic, the average size of lake steamers is much greater than that of the American salt water fleet. Nor is the tonnage of the vessels out of proportion to the amount of freight seeking transportation by them, although there has been much wild guessing as to its volume. It is impossible to be exact in stating the aggregate annual freight movement on the lakes, for the reason that government customs regulations permit vessels to take on or discharge freight at intermediate points without giving an account of its amount. A committee of the Lake Carriers' Association reported in January, 1896, that slightly less than thirty million net tons of freight had been carried by vessels passing the city of Detroit in the year 1895. This statement was based in part upon estimates, and it does not include the commerce between ports on the upper lakes, such as that between Duluth and Chicago. There are about twice as many clearances of vessels from lake ports as there are from all the seaports of the United States. This, however, seems less astonishing when it is remembered that inasmuch as the voyages are short, one vessel clears many times in the course of a season. It must also be remembered in all computations of lake commerce that while there is more or less local traffic on the lower lakes during the entire year, the season for through shipment lasts only while the waterways connecting the lakes are unclosed by ice. Nor should it be forgotten that the figures are of tonnage only ; ocean freights are of much greater intrinsic value.

Although the United States can claim no commercial supremacy upon the high seas, the commerce of the great lakes is almost entirely hers. Only eleven per cent of the tonnage registered upon the lakes is Canadian. Not alone in a commercial sense do the Great Lakes belong to the United States ; much more than half the surface of the lake system lies within the limits of this country. It is a system by no means insignificant in size. From Duluth, at the head of Lake Superior, to Ogdensburg, near the foot of Lake Ontario, the eastern lake port of the United States, the distance is 1235 miles. No other inland waterway equals it in size or in advantage of position, and the shipping upon it attests its importance to the country. The growth of that shipping is remarkable ; probably the history of commerce does not show its counterpart, yet it has by no means attained its greatest proportions. Beyond question its development would be stimulated by the construction of a waterway through which lake freights could reach the ocean without their bulk being broken. At Buffalo, the Erie canal, now being improved by the State of

New York to a navigable depth of eight feet, connects Lake Erie with the Hudson River, but all over the Great Lake basin there is a demand for a deeper canal to tidewater.

The project for a canal by which lake steamers should be enabled to reach the Atlantic is no new thing, and for more than ten years it has been strongly advocated by those interested in the commerce of the lakes. A number of routes for such a waterway have been proposed, but as yet no survey of any one of them has been completed. Owing in great part to the efforts of the Deep Waterway Association, a body composed of men actively concerned in lake shipping, Congress in 1895 created a Deep Waterways Commission for the purpose of investigating the feasibility of building such a canal "as shall enable vessels engaged in ocean commerce to pass to and fro between the Great Lakes and the Atlantic Ocean." Early in the year following, the commission reported that such a canal should ultimately have a depth of twenty-eight feet, and that the government would be justified in undertaking the work. It further recommended that surveys be made for such a canal. Later in the same year Congress appropriated funds for the purpose, and the surveys are now being made.

While the Deep Waterways Commission were engaged upon their labor, Congress authorized the Secretary of War to have made an examination and estimates of cost of a canal "of sufficient capacity to transport the tonnage of the lakes to the sea." Whatever the purpose of Congress may have been, the act was less particular in its terms than the one previously passed, and it allowed an investigation into the question of what depth of canal would be best in the light of all the interests involved. By direction of the Secretary of War a preliminary examination was made by Major Thomas W. Symons, of the Engineer Corps. After careful consideration of the subject Major Symons reported that a ship canal capable of floating a large ocean steamer would not be of sufficient benefit to justify its construction; but that a canal of about 12 feet depth, designed to carry barges of about 1500 tons burden, such as could safely be towed to any part of the Great Lake system, would meet the demands of commerce and should be built.

Two propositions are thus before Congress: first, to construct a 28 foot waterway from the lakes to tidewater, at a total cost of more than $300,000,000, for the surveys of which the sum of $150,000 already has beeen appropriated ; and second, to build a similar canal of a depth of 12 feet, at a cost of about $50,000,000.

It has become apparent that the vessels of the old lake fleet are not able to compete with the larger modern cargo carriers on the same waters. Nevertheless, in order to secure the maximum usefulness of these new vessels and thus enable them to cut rates to the lowest figure, they must be able to carry full cargoes. In order to permit this, further dredging than that at present under way will be required. What was sufficient in 1890 is insufficient to-day ; then 2,500 tons was thought a large cargo on the lakes, whereas 5,000 tons is now common. It must be remembered that through freight rates are established by the large vessels, and it is said that were they able to load to their full capacity they could be operated at a profit on rates much lower than are now charged. What the deepening of the channels means to lake commerce may be shown by a statement made by the builder of one of the large steel ore-carriers recently added to the fleet. He estimated that on a draft of 14½ feet the boat would carry 4,180 tons, and that on a draft of 19 feet it would carry 6,680 tons. The estimate on light draft has been proved by trial to be within the capacity of the vessel, and there is no reason to doubt that the heavier can be carried on the given draft when the connecting channels of the lake system are deep enough to permit it.

Freight boats on the lakes now meet a stronger competition by the railways than ever before, and in this the railways have aided themselves by establishing, between advantageous ports, ferry lines upon which loaded cars are carried, thus enabling them to transfer their freight across a lake without unloading it. The heavy terminal and transfer charges at Chicago are said to have had much to do with the growth of the car ferry system. Inasmuch as a large part of the weight of every car ferry cargo consists of cars, it would seem that the cost of transporting merchandise by car ferry must be very great, and that the maintenance of such ferry lines in places where they are not absolutely necessary is thus a matter of doubtful expedience. Nevertheless, there are more than a dozen lines operating on the lakes. The capacity of the largest ferry is about thirty cars. Of them the one best known is the *Sainte Marie*, plying across the Straits of Mackinac, which is able to crush her way through three feet of ice. Besides the car ferries, many of the larger railways having important lake ports on their routes either own, or operate in connection with, lines of steamers, and thus are able to bill through freight advantageously by a combination of land and water transportation.

The canals built by the United States on the Great Lake system are free in every respect. Of these, that at Sault Ste. Marie is the most important. Nor is its importance only local; in point of tonnage it is the greatest canal in the world. By means of it and the locks at its lower end vessels are enabled to pass the falls of the St. Mary's River, down which the waters of Lake Superior flow to the lower lakes. There are now two locks in the American canal at the "Soo," and one in the canal on the Canadian shore. The American locks lie side by side, and a vessel may pass the falls through either one.

These canals are open to navigation during a season of about 222 days; for the remainder of the year they are closed by ice. In the season of 1895, 17,956 vessels passed through the locks, of an aggregate net registered tonnage of 16,806,781, carrying 15,062,580 tons of freight, the estimated value of which was $159,575,130. During the twelve months of that year, 3,334 vessels, of a net registered tonnage of 8,448,246 passed through the Suez Canal. By way of further comparison, it may be roughly stated that in the same year thirty thousand vessels, with a tonnage of thirty millions, entered and cleared at the ocean and gulf ports of the United States, The tonnage of the St. Mary's Falls Canal represents almost the entire commerce of Lake Superior, as very little of the trade on that lake is local. In 1870, there passed through the canal 691,000 tons of freight; in 1880, 1,734,800 tons; in 1890, the tonnage had increased to 9,041,213, and it bids fair to grow yearly for a long time to come. The freight traffic through the canals in 1897 was almost 2,000,000 tons greater than in the previous year. In spite of this there were fewer vessel passages, thus showing the increase in the size of ships employed. Measured by value, the greatest shipments through the canal are flour, wheat, iron ore, copper, lumber and coal. Of these the first five are carried to Eastern markets; the coal is loaded for the return trip, and the west-bound tonnage, most of which is coal, is only about three-eighths of that east-bound.

A small proportion of the vessels equipped with sails navigate by means of their sail power. These craft ply between intermediate ports and do not engage in through trade from the head to the foot of the Great Lake system. All of them are schooner-rigged, and most of them are towed by steamers, using their sails to aid them only when the wind is fair. Some are thoroughly seaworthy craft, able to fight their way through any weather, but others are bluff tow barges with sail power inadequate for general navigation. In several of the trades on the lakes, particularly the transportation of iron ore, it is the practice to employ fleets of such barges drawn by steamers. This method of transportation is the result of the need for carrying large quantities of heavy bulk freight on shallow draft. It is probable that with increased depth of water it will be less used, although for a number of years it has proved serviceable and economical in the coastwise coal trade on the Atlantic. Such a method of freight-carrying would not be practicable in long voyages on the rougher seas, and the question of its expediency on the lakes yet seems to be somewhat doubtful. In late years steam towing machines have been much used upon the lakes, and by their aid some of the greatest physical disadvantages encountered in such navigation have been obviated. The towing machine consists in brief of a drum controlled by steam cylinders, the hawser being passed around the drum and the resistance of the tow being borne by the cylinders. When the strain on the hawser is suddenly increased by the movement of either vessel in a seaway, the drum pays out the hawser to meet it, gathering the cable again when the unusual strain is eased. With such machines steel towing cables are used; by the old method only hemp hawsers were practicable, for the reason that there is no elasticity in steel, and thus it could not stretch when the steamer and her tow were pitching in a sea.

Some of the tow barges are built of steel, and all of the whalebacks, or "pigs," as the lake sailors call them, are so constructed. The whaleback is another distinct type of lake craft, but one that is far outnumbered by the vessels of the model already described. Some of them are provided with steampower, but most of the fleet are tow barges. The first whaleback was built in 1887. The purpose of the designer was to make a vessel that would be cheap and at the same time have great carrying capacity. It was also claimed that on account of their peculiar shape they would more readily answer the strain of a tow rope. In spite of the claims of their builders, whalebacks have not found general favor in the sight either of lake vessel owners or of sailors. In appearance they are exceedingly awkward craft, but the freshwater Jackie dislikes them because they are uncomfortable in rough weather, and because, as he says, they "ice-up" badly in the winter season.

On no other waters are cargoes of equal size carried on so shallow a draft, and nowhere else has such rapidity in loading and discharging cargo been attained. In a trade, the season for which lasts through only two-thirds of the year, and where the average cargo is carried under 600 miles, a number of trips must be made in a season, and thus speed in handling cargo assumes an importance that it does not have elsewhere. One thousand bushels of wheat a minute is not an uncommon rate at which to load such a cargo. Iron ore is dumped into vessels at the rate of 1,500 tons an hour, and some of the ore docks on Lake Erie are capable of unloading ore ships of from 3,500 to 5,000 tons in twelve hours. There are several car-dumping machines in use on the lakes, by means of which the contents of ordinary coal cars are readily transferred to vessels. With these machines from fifteen to twenty cars of coal can be emptied in an hour, and vessels of 3,500 tons have been loaded in ten hours. The average time consumed by a vessel of the new lake fleet in handling cargo is said to be about fifty-eight days in a season, and the loss of time on account of weather about 4½ days.

Of passenger boats, the twin white steamers *North Land* and *North West*, plying between Buffalo and Duluth, and the black-hulled *Manitou*, running from Chicago to Mackinac, represent the best development of steamship building upon the lakes. The two first named boats are 383 feet long over all, with a horse power of 7,000 and a speed exceeding 21 miles. The *Manitou* is 295 feet over all. These are exclusively passenger boats, and in equipment equal most of the Atlantic liners. Of lake freight boats the *Coralia*, the *Sir Henry Bessemer*, and the *Sir William Siemens*, duplicate vessels, are the finest examples. They are 432 feet over all, with a beam of 48 feet and a depth of 28 feet. The largest of the Canadian fleet is the *Manitoba*, 303 feet over all, with a gross tonnage of 2,615.

The sailor of the Great Lakes has no easy berth; perhaps some phases of his life are harder than those of his salt water brother. In almost every case he has acquired his knowledge of seamanship upon the water he sails, and it is his habit to look down on ocean navigation as an occupation requiring less skill and hardihood. Fierce storms sweep the cruising grounds of each of them, but while the salt water mariner meets rough weather on the open sea, or with land close aboard on but one side of him, the lake sailor is never very far from a lee shore. He is at all times sailing waters more crowded than any part of the Atlantic highway, and from time to time he must pick his course through shallow channels that not only are thronged with shipping, but in themselves are narrow and intricate. It should be remembered, too, that most of the lake harbors are only river mouths, with from 150 to 300 feet of entrance-way, and in most cases they have very small area within. Frequently it is no easy task to enter such a harbor when the wind is blowing a gale and the sea is running high, and the presence of other craft increases the hazard. The shoals which lie outside some of the harbor mouths add to the danger, particularly when the sea is heavy. Vessels are wrecked each year while attempting to enter port. Storms come quickly and with little warning on the Great Lakes, and even in summer these waters sometimes are swept by gales that force the strongest vessels to seek shelter. Moreover, owing to the shortness of the season, lake captains endeavor to keep their vessels in service up to the last possible day, and thus as late as October or November, when navigation is most dangerous, but when the grain crop is moving and freights are high, they brave weather that a more prudent class of seamen would not face.

The lake captain has no knowledge of the science of navigation. Never is he out of sight of land for any length of time, and he must know his route almost as a river pilot knows the stream he sails. In truth, so far as following his course goes, the lake captain is a pilot rather than a seaman. His steering is by compass and the shore line; never does he watch for the sun in order to ascertain his position by an observation. He depends in a large measure upon landmarks in finding his way, and when they are hidden by fog or a snow squall he must make the best guess he can. He has always at least one port to make in a day, and sometimes two or three. In each of them there is enough routine work to keep him busy until he sails again. If he commands a freight boat he often has to shift his vessel from one dock to another, perhaps several times, in order to pick up all his cargo. No pilot meets him off a harbor to share his responsibility and steer his vessel in. He must not only keep the deck during storms and when entering and leaving port, but also during fogs and when the dense smoke from the forest fires of autumn lies on the water, for such well-travelled thoroughfares as he sails demand eternal vigilance. In harbor and at sea, the lake captain's duties are many and his hours of labor long.

The loss of life upon the lakes is said to be greater than that upon the ocean in proportion to the number of sailors employed, although it is much less than formerly. On March 1, 1895, 4,946 vessels were registered on the Great Lakes. During that season of navigation 63 vessels, of an aggregate net tonnage of 48,975, were totally lost, while very many times that number were wrecked or damaged, but not so seriously as to unfit them for future service.

The chief problem in Great Lake navigation to-day is the depth of water. The work of the government in the way of improvement heretofore has been in the deepening and widening of the connecting channels, the dredging and constructing of harbors, and the protecting of waterways. It is possible that a slight but general lowering of the lake levels has resulted, while at the same time the depth of water in the channels has been increased. It does not seem improbable that the further deepening of the channels, the outflow from the Chicago Sanitary and Ship Canal, and the construction of canals now under consideration by the government, will still further lower the levels. To offset this it is now strongly urged that a system of dams equipped with large discharge gates be built at the outlets of the lakes in order that the levels above may be raised, or at least maintained at mean stages. The plan is an adaptation of one that has long been employed by loggers on northwestern rivers. There seems little doubt that the outflow of the Chicago Canal will have an appreciable effect on the level of Lake Michigan. Estimates of the probable fall vary from three inches to one foot. In many of the Lake Michigan ports this will be a matter of very serious importance, for the harbors are already very shallow. In fact, this is true of most of the harbors of the Great Lake system; the depths, as a rule, range from 16 to 18 feet, and many of them are maintained at that stage only by constant dredging. Even without such outlets as the Chicago Canal and the proposed ship or barge canal to the sea, the water levels of the lakes appear to be receding, although insufficient data make it difficult to say how much. The stage of water fluctuates constantly; it is highest in midsummer, and lowest in midwinter or early spring, and the rise and fall varies from one to four feet according to the rainfall. It is seldom that unusually high or low water occurs in all of the lakes at the same time.

The Great Lakes, with their inter-lake channels, have a water surface of 95,965 square miles, and a coast line in the United States of 3,075 miles. The sailing distance from Duluth to Buffalo is 997 miles, and from Chicago to Buffalo the course measures 929 miles. Lake Superior, with an area a little less than that of the State of Maine, is the largest, deepest and most beautiful of the Great Lakes, as it is the highest above the level of the sea. Despite the almost arctic climate of its winter season, the lake never freezes over, although ice closes the harbors and sometimes makes out from the shore for several miles. The snow squalls that sweep the lake with varying frequency during nine months of the year add greatly to the danger of its navigation, while fogs may shut in upon it any time. Its mean level is 601 feet above the sea. St. Mary's River, through which its waters flow to the lower lakes, falls 18½ feet at Sault Ste. Marie.

Lake Michigan and Lake Huron are 580 feet above the sea level, and they are respectively 330 and 263 miles in length. Lake Erie is 250 miles long and has an average depth of only 30 feet in its western portion, while at its deepest point it is only 90 feet. Owing to its shallowness the water of the lake is very easily disturbed by storms, and for this reason lake sailors consider its navigation particularly hazardous. The result of observations upon Lake Erie show that several storms have caused differences in level between the two ends of the lake of from 12 to 15 feet. The mean level is 571 feet above the sea.

Lake Ontario is the smallest and the lowest of the lakes. It is 190 miles long and 245 feet above the sea. The Welland Canal, which connects it with Lake Erie, allows the passage of boats of about 1,700 tons. Lake Ontario has fewer storms n either of the other lakes, and it is not often obstructed by ice.

In these days of great competition, every cut in the operating expenses of a common carrier means a corresponding cut in the rates of transportation. In railway service the cost of operation becomes less as the line of road is straightened, the grades cut down, the curves eased, and the weight and carrying capacity of the rolling stocks increased. So upon the lakes the deepening and straightening of the inter-lake channels, the dredging of the harbors, and the employment of larger vessels, have lessened the cost of moving freight and permitted the reduction of rates. Lake freight rates are already very low. Wheat, for instance, for five years, has been carried from Duluth to Buffalo at a lower average rate per mile than such freight has obtained in the trade across the Atlantic. It is probable that on no other haul of equal length in th world are the freight rates so low as on the lakes at the present time, although the limit of reduction has not yet been reached.

As increased carrying capacity is working a reduction of railway operating expenses in proportion to the amount of freight handled, thus enabling railways to reduce their freight rates, so in order to maintain competition with them the vessels of the lake merchant marine must increase in tonnage. To-day the limit to such increase is the depth of water in the connecting channels. With the completion of the projects in execution or under consideration by the government, the largest vessels now sailing the lakes will be able to load to their full capacity. Twenty feet may be considered the maximum draft that will be practicable in lake navigation for many years to come. Before that navigable depth is open from Duluth to Buffalo, lake shipyards will have produced vessels of such increased length and beam measurements that on the given draft they will have almost the carrying capacity of the largest cargo steamers in use to-day upon the ocean. The present tendency is strongly toward the employment of larger vessels, and the astonishing growth of lake traffic would seem to promise that it will always justify the use of the largest carriers the channels will float.

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